



US009409229B2

(12) **United States Patent**
Watanabe et al.

(10) **Patent No.:** **US 9,409,229 B2**
(45) **Date of Patent:** **Aug. 9, 2016**

(54) **METHOD FOR CONTINUOUSLY CASTING SLAB**

11/041 (2013.01); *B22D 11/1206* (2013.01);
B22D 11/1282 (2013.01); *B22D 11/1287*
(2013.01);

(71) Applicant: **NIPPON STEEL & SUMITOMO METAL CORPORATION**, Tokyo (JP)

(Continued)

(72) Inventors: **Shinsuke Watanabe**, Nogata (JP);
Toshihiko Murakami, Kashima (JP)

(58) **Field of Classification Search**

CPC .. *B22D 11/04*; *B22D 11/1206*; *B22D 11/128*;
B22D 11/1282; *B22D 11/143*; *B22D 11/208*;
B21B 1/46

(73) Assignee: **NIPPON STEEL & SUMITOMO METAL CORPORATION**, Tokyo (JP)

USPC *164/441*, *442*, *448*, *462*, *476*, *484*
See application file for complete search history.

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,491,823 A * 1/1970 Tarmann *B21B 1/026*
164/476
5,497,821 A * 3/1996 Arvedi *B22D 11/1206*
164/417

(21) Appl. No.: **14/892,234**

(Continued)

(22) PCT Filed: **Jun. 18, 2014**

(86) PCT No.: **PCT/JP2014/066180**

FOREIGN PATENT DOCUMENTS

§ 371 (c)(1),
(2) Date: **Nov. 19, 2015**

JP 03198964 A * 8/1991
JP 10146651 A * 6/1998

(87) PCT Pub. No.: **WO2014/203937**

(Continued)

PCT Pub. Date: **Dec. 24, 2014**

Primary Examiner — Kevin E Yoon

(74) Attorney, Agent, or Firm — Clark & Brody

(65) **Prior Publication Data**

US 2016/0096219 A1 Apr. 7, 2016

(57) **ABSTRACT**

A main purpose of the present invention is to provide a continuous casting method for a slab satisfying reductions of center segregation and center porosity, and inhibitions of surface cracks and internal cracks of a slab. The method includes a step of carrying out reduction on a slab having an unsolidified part by horizontal rolls and a step of alternatively carrying out reduction on the slab completely solidified by horizontal rolls and vertical rolls, wherein in the former step, reduction ratio of the slab is more than 0.5% and no more than 3% and a ratio of a width of the unsolidified part at the cross section of the slab to a width of a contact part of the slab and the rolls is 0 to 7.15, and in the latter step, each reduction ratio of the slab by the rolls is 5.4% to 6.8%.

(30) **Foreign Application Priority Data**

Jun. 20, 2013 (JP) 2013-129089

(51) **Int. Cl.**
B22D 11/128 (2006.01)
B22D 11/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC *B22D 11/001* (2013.01); *B22D 11/00*
(2013.01); *B22D 11/04* (2013.01); *B22D*

8 Claims, 4 Drawing Sheets

